

## CLAIMS

What is claimed is:

1. A method of detecting misfire in an engine comprising:
  - detecting engine speed fluctuations;
  - determining a linear model for estimating engine firing events based on the engine speed fluctuations;
  - applying a Kalman filter to the linear model to determine parameters of the linear model; and
  - detecting a misfire event in the engine based on the linear model.
2. The method of claim 1 further comprising representing the linear model as a difference equation.
3. The method of claim 2 further wherein applying the Kalman filter includes estimating parameters of the difference equation.
4. The method of claim 1 further comprising reformulating the linear model using standard state space systems equations.

5. The method of claim 1 further comprising determining a load compensator signal based on an engine speed and a manifold absolute pressure, wherein detecting the misfire event includes detecting the misfire event based on the firing event signal and the load compensator signal.

6. A method of detecting misfire in an engine comprising:
  - detecting crankshaft speed fluctuations in the engine;
  - determining a linear model for estimating engine firing events based on the crankshaft speed fluctuations;
  - representing the linear model as a difference equation;
  - estimating parameters of the difference equation at a Kalman filter to determine a firing event model; and
  - detecting a misfire event in the engine based on the firing event model.

7. A misfire detection system that detects misfire in an engine comprising:

a sensor that determines speed fluctuations of the engine;

a controller that executes a firing event model for estimating engine firing events based on the engine speed fluctuations and that applies a Kalman filter to the model; and

a misfire detector that detects a misfire event based on the model.

8. A misfire detection system according to claim 7 wherein the firing event model is a difference equation.

9. A misfire detection system according to claim 8 wherein the Kalman filter estimates parameters of the difference equation.

10. The method of claim 7 wherein the controller determines a load compensator signal based on an engine speed and a manifold absolute pressure, and wherein the misfire detector detects the misfire event based on the firing event model and the load compensator signal.